

Remarks:

Reconsideration of the application is requested.

Claims 1 and 4-12 remain in the application. Claim 1, 5-6, 8 and 12 have been amended. Claims 2-3 have been cancelled.

In item 2 on pages 2-3 of the above-mentioned Office action, claims 1, 4 and 5 have been rejected as being anticipated by Zurcher et al. (US Pat. No. 6,344,413) under 35 U.S.C. § 102(e).

The rejection has been noted and claim 1 has been amended in an effort to even more clearly define the invention of the instant application. More specifically, the feature of claim 3 has been added to claim 1.

Before discussing the prior art in detail, it is believed that a brief review of the invention as claimed, would be helpful.

Claim 1 calls for, inter alia:

forming the structures on the substrate with an aspect ratio of greater than 2 from a material selected from the group consisting of noble metals, oxides of noble metals, and ferroelectric materials;

depositing a sacrificial layer on the structures and the substrate; and

removing the structures and the sacrificial layer in a polishing step.

Zurcher et al. disclose a method for forming a semiconductor device. In the substrate 60, a cavity is provided in which a capacitor formed of the electrodes 70 and 80 and a dielectric 75 is embedded. Then, the sacrificial layer 85 is formed thereon and etched in a CMP step until the structure shown in Fig. 7 is achieved.

However, as the Examiner states in the second paragraph in item 4 on page 3 of the Office action, Zurcher et al. do not disclose the specific aspect ratio.

Clearly, Zurcher et al. do not show "forming the structures on the substrate with an aspect ratio of greater than 2 from a material selected from the group consisting of noble metals, oxides of noble metals, and ferroelectric materials", as recited in claim 1 of the instant application.

Claim 1 is, therefore, believed to be patentable over Zurcher et al. and since claims 4-5 are dependent on claim 1, they are believed to be patentable as well.

In item 4 on page 3 of the above-mentioned Office action, claims 3 and 7 have been rejected as being unpatentable over Zurcher et al. in view of Paranjpe (US Pat. No. 5,434,107) under 35 U.S.C. § 103(a).

Since the feature of claim 3 has been added to claim 1, the following discussion is therefore directed to claim 1.

As discussed above, Zurcher et al. do not disclose the specific aspect ratio as recited in amended claim 1.

The Examiner has cited column 2, lines 44-46 of Paranjpe as disclosing the specific aspect ratio. The cited lines in Paranjpe read:

"The polishing rates are a function of many variables including feature size, aspect ratio, feature density and material type."

The cited lines are well known in the art, but do not disclose or provide any hint about how amended claim 1 could be derived from Zurcher et al. in view of Paranjpe. The invention of the instant application is related to the removal of structures which are formed during etching on the side walls of masks. These redepositions are distinguished by a large aspect ratio greater than 2 and by the fact that they cannot be removed by

applying conventional methods such as polishing, ultrasound action or high-pressure liquid jets.

As described on pages 4-5 of the specification of the instant application, the structures break off thereby damaging the underlying structure or smearing the underlying structure. In order to overcome these problems, the invention of the instant application teaches firstly to apply a sacrificial layer on these structures, and secondly to etch the whole layer including the structures. This problem is mentioned neither in Zurcher et al. nor in Paranjpe. Neither Zurcher et al. nor Paranjpe are related to the problem of removing structures of a large aspect ratio. Paranjpe is only related to the planarization of the upper surface of a semiconductor wafer.

It is accordingly believed to be clear that none of the references, whether taken alone or in any combination, either show or suggest the features of claim 1. Claim 1 is, therefore, believed to be patentable over the art and since claim 7 is dependent on claim 1, it is believed to be patentable as well. Claim 3 has been cancelled.

In item 5 on page 4 of the above-mentioned Office action, claim 6 has been rejected as being unpatentable over Zurcher et al. in

view of Ismail et al. (US Pat. No. 5,955,759) under 35 U.S.C. § 103(a).

As discussed above, claim 1 is believed to be patentable over the art. Since claim 6 is ultimately dependent on claim 1, it is believed to be patentable as well.

In item 6 on pages 4-6 of the above-mentioned Office action, claims 8-12 have been rejected as being unpatentable over Chien et al. (US Pat. No. 5,702,869) in view of Huff et al. (US Pat. No. 5,872,401) under 35 U.S.C. § 103(a).

As will be explained below, it is believed that claims 8-12 were patentable over the cited art in their original form and the claims have, therefore, not been amended to overcome the references. However, the word "sacrifice" has been changed to "sacrificial".

Before discussing the prior art in detail, it is believed that a brief review of the invention as claimed, would be helpful.

Claim 8 recites a method for producing at least one structured layer, which comprises the steps of:

- a) providing a substrate;

- b) applying at least one layer to the substrate for structuring;
- c) applying a mask to the layer to be structured;
- d) etching the layer being structured by a dry etching method, so that redepositions of the layer emerge at sidewalls of the mask;
- e) removing the mask;
- f) applying a sacrificial layer; and
- g) performing a polishing step to remove the redepositions of the layer being structured, and to remove the sacrificial layer, so that a structured layer emerges.

As already discussed in the response to the previous Office action, Chien et al. do not disclose steps f) and g) of claim 8 (see also the fourth paragraph on page 5 of this office action). In Chien et al., redepositions are removed by employing an oxygen containing plasma (see column 9, lines 35-36) in a first step and a wet chemical etch method (see column 10, lines 15-19) in a second step. By performing those steps, none of the surrounding layers are removed and the other structure is maintained.

In the response to the previous Office action, Applicants have argued that the reference Chien et al. is not applicable to claim 8 because a polishing step which includes removing all of the redeposition would mean reducing the height of the inter-metal dielectric layers 24a, 24b or 32a, 32b to the height of the conductor layers 22a, 22b or 30a, 30b, respectively, which is a contradiction to Fig. 9. The Examiner has stated that

claim 8 does not require the removal of all of the redepositions. However, even if the Examiner's interpretation of claim 8 is followed, it is impossible to arrive from Figs. 4 and 8 of Chien et al., respectively, to Figs. 5 and 9 of Chien et al. by applying the method according to claim 8 of the instant application.

If the redepositions are removed to a certain height by performing a polishing step, the surroundings are removed to the same level. In Chien et al., however, all the surroundings are of fundamental importance: the conductive interconnection studs 28a, 28b, 36a and 36b could not be formed if polishing were to be performed to the height of 22a, 22b and 30a, 30b, respectively. If polishing stops on a higher level, the residues on the sidewalls of the studs would not be removed which influences the device's operativeness. Moreover, if the redepositions 27a', 27b', 27c', 27d' and 35a', 35b', 35c', 35d', respectively, were removed only above the bottom level of 26a', 26b', 26c' and 34a', 34b', 34c', respectively, the conductor layers 30a, 30b and 38a, 38b, respectively, could not be formed. That is exactly why Chien et al. teach a method of removing the residues by plasma and chemical etching which does not influence the surrounding materials. Therefore, a person

skilled in the art would not be able to arrive the method of claim 8 of the instant application from Chien et al.

The Examiner has stated that Huff et al. disclose the steps f) and g) of claim 8 of the instant application, namely, f) applying a sacrificial layer; and g) performing a polishing step to remove the redepositions of the layer being structured, and to remove the sacrificial layer, so that a structured layer emerges.

It is noted that according to step d) of claim 8 of the instant application, the redepositions of the layer emerge at the sidewalls of the mask. In Huff et al., however, there is no mask. Therefore, Huff et al. are not concerned with the problem of redepositions at the sidewalls of the mask.

Moreover, as can be clearly seen from Figs. 3E, 3F and 3G together with the corresponding text of Huff et al., redepositions 370 and 375 as well as the small voids 380 are below the metal height of the metal structures 310, 320 and 330. Consequently, they are not supposed to be removed by the planarization process because the process has to be stopped above the metal height. Thus, Huff et al. teach maintaining redepositions and small voids within the planarized complete

ILD 400. According to step g) of claim 8 of the instant application, however, the polishing step is performed to remove the redepositions. Therefore, Huff et al. apparently teach away from the method of claim 8 of the instant application.

It is accordingly believed to be clear that none of the references, whether taken alone or in any combination, either show or suggest the features of claim 8. Claim 8 is, therefore, believed to be patentable over the art and since claims 9-12 are dependent on claim 1, they are believed to be patentable as well.

In view of the foregoing, reconsideration and allowance of claims 1 and 4-12 are solicited.

In the event the Examiner should still find any of the claims to be unpatentable, counsel would appreciate a telephone call so that, if possible, patentable language can be worked out.

If an extension of time for this paper is required, petition for extension is herewith made. Please charge any fees which might be due with respect to Sections 1.16 and 1.17 to the Deposit

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Respectfully submitted,



For Applicants

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